INTERNATIONAL STANDARD

ISO 11058

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Geotextiles and geotextile-related products — Determination of water permeability characteristics normal to the plane, without load

Géotextiles et produits apparentés — Détermination des caractéristiques de perméabilité à l'eau normalement au plan, sans contrainte mécanique

Foreword

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International Standard ISO 11058 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 21, *Geotextiles*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read “..this European Standard...” to mean “...this International Standard...”.

Annexes A to D of this International Standard are for information only.

Annex ZZ provides a list of corresponding International and European Standards for which equivalents are not given in the text.

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Foreword

The text of EN ISO 11058:1999 has been prepared by Technical Committee CEN/TC 189 "Geotextiles and geotextile-related products", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 38 "Textiles".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies two test methods for determining the water permeability characteristics of a single layer of geotextile or geotextile-related product normal to the plane: the constant head method and the falling head method.

NOTE: If the full permeability characteristics of the geotextile or geotextile-related product have previously been established, then for control purposes it can be sufficient to determine the velocity index at a head loss of 50 mm only.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 963	Geotextiles and geotextile-related products - Sampling and preparation of test specimens
EN 30320	Geotextiles - Identification on site (ISO 10320:1991)
ISO 2854	Statistical interpretation of data - Techniques of estimation and tests relating to means and variances
EN ISO 5813	Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983)

3 Definitions

For the purposes of this standard, the following definition applies:

3.1 velocity index (VI_{H50}): The velocity corresponding to a head loss of 50 mm across a specimen, expressed to the nearest 1 mm s^{-1}.

4 Test specimens

4.1 Handling

The sample shall not be folded and shall be handled as infrequently as possible to avoid disturbance to its structure. The sample shall be kept in a flat position without any load.

4.2 Selection

Take specimens from the sample according to EN 963.

4.3 Number and dimensions

Cut five test specimens from the sample, each of suitable dimensions for the water permeability apparatus to be used.

NOTE: Where it is necessary to determine the results to within a given confidence interval of the mean, the number of test specimens should be determined in accordance with ISO 2854.

4.4 Condition of specimens

The specimens shall be clean, free from surface deposits and without visible damage or folding marks.

5 Constant head method

5.1 Principle

A single, unloaded layer of geotextile or geotextile-related product is subjected to a unidirectional flow of water normal to the plane under a range of constant heads.

5.2 Apparatus

5.2.1 A transparent water-permeability apparatus with a diameter of minimum 50 mm shall comply with the following requirements:

a) The apparatus shall be capable of installing a maximum head loss of at least 70 mm and maintaining a constant head for the duration of each test with water on both sides of the specimen. It shall be capable of achieving a constant water head of up to 250 mm;

NOTE: Some examples of apparatus are shown in figure 1.

b) The mean internal diameter of the apparatus shall be known to an accuracy of at least 0,1 mm. The exposed diameter of the specimen shall be the same as the internal diameter of the apparatus. The diameter of the apparatus shall remain identical on both sides of the specimen over a length of at least twice its internal diameter (see figure 1a and figure 1b). Abrupt changes in diameter shall be avoided.
Alternatively (see figure 1c), the outflow may discharge into a reservoir with a diameter of at least four times the exposed diameter of the specimen. In this case the distance from the geotextile to the base of the reservoir shall be at least 1,5 times the exposed diameter of the specimen.
If the product shows an obvious pattern, this pattern shall be included at least 3 times along any diameter of the specimen.

c) Where necessary, to avoid any visible deformation, a grid of 1 mm diameter wire and a mesh size of (10 ± 1) mm shall be placed downstream of the specimen to support it during the test.

d) The head loss measured at any velocity when a test is performed without the test specimen but including any specimen-supporting grid, shall be less than 1 mm.

5.2.2 Water supply, quality and condition

a) The water shall be at a temperature of between 18 °C and 22 °C.

NOTE: As the temperature correction (see annex A) relates only to laminar flow, it is advisable to work at temperatures as close as possible to 20 °C to minimize inaccuracies associated with inappropriate correction factors, should the flow be non-laminar.

b) Water may not be fed into the apparatus directly from a mains supply due to problems caused by the release of air bubbles which can be entrapped in the structure of the specimen. The water should preferably be de-aired or fed from a stilling tank. The water should not be continuously recycled.

c) The oxygen content shall not exceed 10 mg/kg. The oxygen content shall be measured at the point at which the water enters the apparatus.

d) The water shall be filtered if suspended solids are visible to the naked eye or if solids accumulate on or in the specimen thus reducing the flow with time.

5.2.3 A dissolved-oxygen meter or apparatus complying with ISO 5813.

5.2.4 A stopwatch with an accuracy of 0,1 s.

5.2.5 A thermometer with an accuracy of 0,2 °C.

5.2.6 A measuring vessel for determining volume of water to an accuracy of 10 cm^3. Alternatively where direct measurements of flow velocity are made, the gauge shall be calibrated to an accuracy of 5 % of the reading.

5.2.7 A measuring device to determine the applied head to an accuracy of 0,2 mm.

5.3 Procedure

5.3.1 Place the specimens under water containing a wetting agent at laboratory temperature, gently stir to remove air bubbles and leave to saturate for at least 12 h. The wetting agent is aryl alkyl sodium sulfonate at 0,1 % V/V content.

5.3.2 Place a specimen in the apparatus and ensure that all joints are watertight.

5.3.3 Charge the apparatus with water until there is a 50 mm water head difference across the specimen. Shut off the water supply and if the water heads do not equalize on each side of the specimen within 5 min, investigate the likelihood of any trapped air within the apparatus and repeat the procedure. If the water heads cannot be equalized within 5 min, this shall be noted in the test report.

5.3.4 Adjust the flow to attain a head loss of (70 ± 5) mm and record this value to the nearest 1 mm. When the head has been steady for a minimum of 30 s, collect the water passing through the system in the measuring vessel over a fixed period of time and record the volume of water collected to the nearest 10 cm³ and the time to the nearest s. The volume of water collected should be a minimum of 1000 cm^3 and the collection time should be a minimum of 30 s.

If a flow velocity gauge is used, then a maximum velocity giving a head loss of about 70 mm should be set. The real velocity shall be taken as the average of three consecutive readings with a minimum time interval between readings of 15 s.

5.3.5 Repeat 5.3.4 for four lower head losses of approximately 0,8; 0,6; 0,4 and 0,2 times the maximum head loss starting with the highest velocity and ending with the lowest.

NOTE: If the full permeabillity characteristics of the geotextile or geotextile-related product have previously been established, then for control purposes it can be sufficient to determine the velocity index at a head loss of 50 mm only.

The same principle applies to the velocity when using a flow velocity gauge.

5.3.6 Record the water temperature to the nearest 0,2 °C.

5.3.7 Repeat 5.3.2 to 5.3.6 with each of the remaining specimens.

5.4 Calculation and expression of results

5.4.1 Calculate the flow velocity v_{20} (m s^{-1}) at 20 °C using the following equation:

$$v_{20} = \frac{V\ R_T}{A\ t} \qquad (1.1)$$

where:

V is the water volume measured (m^3)

R_T is the correction factor to a water temperature of 20 °C (see annex A)

T is the water temperature (°C)

A is the exposed specimen area (m^2)

t is the time measured to achieve the volume V (s).

Where the flow velocity v_T has been measured directly, a temperature correction is necessary according to: $v_{20} = v_T R_T$ (1.2)

NOTE: The flow velocity v_{20} expressed in mm s^{-1} equals the discharge q expressed in l $(m^2 s)^{-1}$.

5.4.2 For each of the five specimens, calculate the flow velocity v_{20} for each head loss H.

Plot the head loss H against velocity v_{20} and select the best-fit curve through the origin for each specimen (see figure 2) in accordance with annex B, either by mathematical or graphical means. Present the five specimen curves on one graph.

As indicated in the note in clause 1, it can be sufficient, for control purposes, to determine the flow velocity value at a head loss of 50 mm only.

5.4.3 Produce a flow velocity value at the head loss of 50 mm either by calculation or by graphical interpretation.

6 Falling head method

6.1 Principle

A single unloaded layer of geotextile or geotextile-related product is subjected to a unidirectional flow of water normal to the plane under a falling head.

6.2 Apparatus

6.2.1 A transparent water-permeability apparatus consisting of two interconnected vertical cylinders of the same diameter of minimum 50 mm, complying with the following requirements:

a) The apparatus shall be capable of achieving water heads of at least 250 mm for appropriate calculations.

NOTE 1: To achieve a water head of at least 250 mm it is recommended to start with a higher water level because the water head values recorded during the opening time of the valve cannot be used for calculation.

b) The mean internal diameter of the apparatus shall be known to an accuracy of at least 0,1 mm. The exposed diameter of the specimen shall be the same as the internal diameter of the apparatus. The diameter of the apparatus on both sides of the specimen shall remain identical over a length of at least twice its internal diameter. Within the range of changing water levels the diameter shall be constant. Abrupt changes in diameter should be avoided.

If the product shows an obvious pattern, this pattern shall be included at least 3 times, along any diameter of the specimen.

c) Where necessary, to avoid any visible deformation, a grid of 1 mm diameter wire and a mesh size of (10 ± 1) mm shall be placed downstream of the specimen to support it during the test.

d) The head loss measured at any velocity when a test is performed without the test specimen but including any specimen-supporting grid, shall be less than 1 mm.

NOTE 2: Some examples of apparatus are shown in figure 3.

e) The connecting tube between the two cylinders shall have a minimum diameter of 40 % of the diameter of the cylinders. It shall be flexible if the weighing cell method is used.

6.2.2 Water supply, quality and condition:

a) The water shall be at a temperature between 18 °C and 22 °C.

NOTE: As the temperature correction (see annex A) relates only to laminar flow it is advisable to work at temperatures as close as possible to 20 °C to minimize inaccuracies associated with inappropriate correction factors, should the flow be non-laminar.

b) Water may not be fed into the apparatus directly from a main supply due to problems caused by the release of air bubbles which can lodge in the test specimen. The water should be preferably de-aired or fed from a stilling tank. The water in the apparatus should be replaced daily.

c) The oxygen content shall not exceed 10 mg/kg. The oxygen content shall be measured at the point at which the water enters the apparatus.

d) The water shall be filtered if suspended solids are visible to the naked eye or if solids accumulate on or in the specimen thus reducing the flow with time.

6.2.3 A dissolved-oxygen meter or apparatus complying with ISO 5813.

6.2.4 Means for measuring the changing water head to an accuracy of 0,2 mm.

NOTE 1: Possible means are:

a) measuring the change in column weight (to ± 1 g);

b) measuring the change in water pressure (to ± 1 Pa);

c) measuring the change in water level by an optical method (reading of water level using digitalized video equipment) or by an ultrasonic method.

NOTE 2: Continuous recording of the data by an analogue writer or computer from the beginning to the end of the test is recommended (see figure 4).

6.2.5 A thermometer with an accuracy of 0,2 °C.

6.3 Procedure

6.3.1 Place the specimens under water at laboratory temperature, gently stir to remove air bubbles and leave to saturate for at least 12 h. Aryl alkyl sodium sulfonate at 0,1 % V/V is added as a wetting agent.

6.3.2 Place a specimen in the apparatus and ensure that all joints are watertight.

6.3.3 Charge the apparatus with water until there is a 50 mm water head difference across the specimen. Shut off the water supply and if the water heads do not equalize on each side of the specimen within 5 min, investigate the likelihood of any trapped air within the apparatus and repeat the procedure. If the water heads cannot be equalized within 5 min, this shall be noted in the test report.

6.3.4 Close the valve. Charge the specimen cylinder of the apparatus to a height such that a useful head difference of at least 250 mm after complete opening of the valve is achieved (see NOTE 1 of 6.2.1).

6.3.5 Record the water temperature to the nearest 0,2 °C.

6.3.6 Switch on all instruments required for the method used (see notes in 6.2.4) and open the valve.

6.3.7 The test ends when head loss and flow velocity reach zero.

NOTE: For highly permeable specimens, the water levels at $v = 0$ ms^{-1} may not be equalized due to inertia effects (see figure 4). In this case the water level corresponding to $v = 0$ m s^{-1} for the first time is taken as the reference level for calculating head losses.

6.3.8 Repeat 6.3.2 to 6.3.7 with each of the remaining specimens.

6.4 Calculation and expression of results

6.4.1 From a chosen water-level interval on the graph of the analogue writer (see figure 4) or the computerized data, calculate the flow velocity v_{20} (m s^{-1}) at 20 °C using the following equation:

$$v_{20} = \frac{\Delta h}{t} R_T \qquad (2)$$

where:

Δh is the difference between the upper water level h_u and the lower water level h_l (m) at the time interval (t)

t is the time interval between h_u and h_l (s)

R_T is the correction factor to a water temperature of 20 °C (see annex A)

and the head loss H (m) which is given by:

$$H = h_u + h_l - 2\,h_0 \qquad (3)$$